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Signed J Evans

Dated 31 July 2000

Patents Form 1/77

1977

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20 JUL 1999 The Patent Office
Cardiff Road
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1. Your reference — DC/SPX5TH003/44063

2. Patent application number *(The Patent Office will fill in this part)*

3. Full name, address and postcode of the or of each applicant *(underline all surnames)* — STATUS HI-TECH LTD
71 ALBANY ROAD
COVENTRY
CV5 4JR

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation — UNITED KINGDOM

07416654009.

4. Title of the invention — A SWITCH

5. Name of your agent *(if you have one)* — WITHERS AND ROGERS

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)* —
GOLDINGS HOUSE
2 HAYS LANE
LONDON
SE1 2HW

Patents ADP number *(if you know it)* — 0000 1776001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
–		

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*
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8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d)) — YES

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Continuation sheets of this form	–
Description	10
Claim(s)	–
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Drawing(s)	1

10. If you are also filing any of the following, state how many against each item.

Priority documents	–
Translations of priority documents	–
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	–
Request for preliminary examination and search *(Patents Form 9/77)*	–
Request for substantive examination *(Patents Form 10/77)*	–
Any other documents *(please specify)*	–

11. I/We request the grant of a patent on the basis of this application.

Signature Withers & Rogers Date 16.7.99.

WITHERS AND ROGERS

12. Name and daytime telephone number of person to contact in the United Kingdom: D CROSTON 01926 336111

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A SWITCH

The invention relates to a switch and particularly to, although not exclusively limited to, a switch which requires no physical contact with a circuit.

Switches for electrical circuits normally comprise a physical break in the circuit which allows an operator to complete the circuit by actuating an appropriate lever. Conventional electric light switches are an example of such an arrangement where an insulated lever is connected to a break in the circuit and actuation of the lever completes the circuit to allow the light to be activated. Such switches have several drawbacks. Firstly, because the switch is a mechanical interface with the circuit the switch is subject to wear and may eventually fail. More importantly, conventional light switches cannot be used in environments where there is a likelihood that conductive material could cause either shorting of the circuit or an electric shock hazard. An example of such an environment would be a bathroom where there is a likelihood that the user may have wet hands when activating the switch. That presents significant risks of electric shock to the user. Consequently, such switches are not used in bathrooms and the switch is either arranged outside the bathroom or alternatively the switch is located in the ceiling and is actuated by means of a pull string.

It is an object of the invention to provide an improved switch.

According to the invention there is provided a switch device comprising a switch oscillator arranged to oscillate at a predetermined frequency, the switch oscillator being arranged so that the frequency thereof changes in response to a switch activating presence, a reference

oscillator arranged to oscillate at a reference frequency and a comparator, the comparator receiving signals from the switch oscillator and the reference oscillator and being arranged to sense differences in the frequencies of the signals from the oscillators, the comparator being arranged to send a switching signal to a switch when the difference between the reference oscillator frequency and the switch oscillator frequency exceeds a predetermined level.

In that way a non-mechanical switch is provided which enables a circuit to be switched without physical contact by the user since the switch activation presence can be the physical proximity of, for example the user's hand, to the switch oscillator. There is no requirement for physical contact with the device since physical proximity of the user's hand with the switch oscillator will change the switch oscillator fundamental frequency which will activate the switch. The switch activation presence could also be an inanimate object and there is no need for the object to be conductive. Proximity of any object to the switch oscillator will cause stray capacitance in the oscillator and hence change the oscillator characteristics and operating frequency.

Because the switching is non-mechanical, the possibility of the switch arcing is eliminated. That renders the switch safe for use in areas of explosion hazard, for example petrol station forecourts, and places where flammable gas is used or stored.

Preferably, the switch oscillator is arranged adjacent a face plate and the user places his/her hand adjacent the face plate or touches the face plate in order to activate the switch. The plate is preferably made from electrically insulating material, most preferably bakelite (registered

trade mark). The face plate is preferably arranged so that it can be retrofit to existing switch mountings. Alternatively, the face plate may be designed as a bespoke plate.

The comparator preferably comprises a low pass filter which feeds back a signal to the reference oscillator whereby small differences between the reference oscillator frequency and the switch oscillator frequency are fed back to the reference oscillator so that the reference oscillator can change its reference frequency. That is so that changes in ambient conditions such as changes in temperature, humidity etc which may effect the frequency of oscillation of the switch oscillator are reflected in the frequency of oscillation of the reference oscillator. That ensures that the switch is only activated when the user wishes the switch to be activated.

Preferably, the switching signal from the comparator passes through a time delay/filter latching circuit. In that way, erroneous signals, such interference or noise or alternatively transient signals which might be generated by a user walking passing the switch are eliminated so as to avoid erroneous activation of the switch.

Preferably, the components of the switching device are arranged on a printed circuit board.

In a third embodiment several such switching devices may be arranged on a single circuit board adjacent a single face plate. In such a case the face plate may have markings thereon to illustrate where a user should touch the face plate in order to activate particular individual switching devices.

In one embodiment the switching device can be used to switch a light circuit. In such a case various control functions can be effected by means of the switch controlled by software in the light circuit.

A specific embodiment of the invention will now be described by way of example with reference to the accompanying drawing, in which:

Fig. 1 shows a schematic circuit diagram of a contactless switch in accordance with the invention.

Referring to Fig. 1, a contactless switch 10 comprises a sensor part 12 and a switch part 14.

The sensor part 12 comprises a face plate 16, a switch sensing oscillator 18 responsive to activation of the face plate 16, a reference oscillator 20 and a phase comparator 22 which is arranged to compare the frequencies of the oscillators 18, 20 through a control loop 23 and to generate a signal A when the frequency difference is above a threshold level.

The switch part 14 comprises a time delay/filter latching circuit 24, an amplifier 26 connected to the latching circuit 24 and a semiconductor power switch 28 connected to the amplifier 26.

The switch sensing oscillator 18, reference oscillator 20, phase comparator 22, latching circuit 24, amplifier 26 and power switch 28 are mounted on a printed circuit board 30.

The plate 16 is made from an electrically insulating material such as Bakelite (RTM). The plate 16 has a front surface 32 and a rear surface 34. The plate 16 is mounted such that its front surface 32 faces an operator and its rear surface 34 faces the printed circuit board (PCB) 30 and, in particular, the switch sensing oscillator 18. The face plate 16 is designed to fit pre-existing switch mountings.

The switch sensing oscillator 18 is an oscillator of known type which comprises a resistive component such as a resistor 36 and a capacitive component 38. The oscillator 18 has a fundamental frequency determined by its capacitive component 38. The resistor 36 is arranged adjacent, and in contact with, the rear surface 34 of the face plate 16 such that it cannot be contacted by an operator approaching the front surface 32. The resistor 36 is one of the main frequency determining components of the switch sensing oscillator 18 and activation of the resistor 36 lowers the frequency of the switch sensing oscillator 18. Due to the arrangement, an output of the switch sensing oscillator 18 can pass through the resistor 36 and then form the next input to the switch sensing oscillator 18.

A low pass filter 40 is arranged in the control loop 42 with the reference oscillator 20. The reference oscillator 20 is voltage controlled.

The phase comparator 22 has a detector (not shown) that allows the reference oscillator 20 to become phase-locked with the switch sensing oscillator 18. In that way, a signal from the switch sensing oscillator 18 is locked to the stable frequency from the reference oscillator 20. When the switch sensing oscillator 18 is not locked to the reference oscillator 20, it is otherwise uncontrolled.

The semiconductor power switch 28 comprises a triac 44 to allow control of the alternating current. The semiconductor power switch 28 is connected to an external circuit 46 and a feedback circuit 48.

The external circuit 46 may be a light circuit for example;

The feedback circuit 48 is connected, for example via a capacitor (not shown), to the sensor part 12 and provides sufficient power to operate circuitry in the sensor part 12.

In operation, the switch sensing oscillator 18 generates a signal which passes to the phase comparator 22. The reference oscillator 20 generates pulses at a constant rate to provide a signal at a similar frequency to the switch sensing oscillator 18.

The two signals are compared and when the magnitude of difference between the two signals is below a certain threshold the signals stay "in lock". When "in lock", no signal passes from the phase comparator 22 to the filter 24 so there is no change to the switch 28.

Changes in the environmental conditions (ie. a change in the temperature and/or pressure) can cause a change in the fundamental frequency of the switch sensing oscillator 18. The low pass filter 40 passes low threshold difference signals below the "out of lock" threshold back to the reference oscillator 20 as a feedback signal. The reference oscillator 20 adjusts its reference frequency in response to the feedback signal so as to bring itself in line with the fundamental frequency of the switch sensing oscillator 18.

An operator applying a hand, other part of the body or any other dense object onto, or close to (for example within 5MM of), the front surface 32 of the plate 16 will cause stray capacitance in the capacitive component 38 of the switch sensing oscillator 18 and a change in the frequency of the switch sensing oscillator 18 will result. The reduction in the frequency of the signal is detected by the phase comparator 22. When the difference between the frequency of the switch sensing oscillator 18 and the frequency of the reference oscillator 20 rises over a certain threshold, the phase comparator 22 moves into an "out of lock" condition.

A signal A is then sent from the phase comparator 22 to the time delay/filter latching circuit 24 to indicate that the power switch 28 should be "switched". The time delay/filter latching circuit 24 eliminates stray interference from the signal A and holds the sensor part 12 in position. The time delay from the filter 24 ensures that the plate 16 has been activated deliberately and not accidentally triggered. The signal then passes through the amplifier 26 to the semiconductor power switch 28 that switches on the external circuit 46. For example, a light circuit may be switched on to activate a light bulb (not shown). Repeating the above action causes the external circuit to be switched off.

The plate 16 may be made from a conductive material because the separation of the plate from the PCB 30 means that the contactless switch 10 of the present invention does not expose the user to an electric shock hazard. Consequently, the present invention is particularly useful where a risk of electric shock exists, for example in bathrooms, kitchens, shower enclosures, steam rooms etc.

Where control of a d.c. circuit is desired the semiconductor power switch 28 may comprise a transistor.

The printed circuit board 34 may have a plurality of sensor parts 12 and switch parts 14 positioned on it, thus making multiple switching possible from a single plate 16. Inked printed text and/or margins could be applied to the front surface 32 of the plate 16 sharing the various touch positions. The rear surface 34 may be fitted with one or more low intensity light emitting indicators which illuminate, thereby making the plate 16 visible in darkness.

The contactless switch 10 may comprise a software-controlled micro circuit or controllers to achieve the switching.

A further embodiment of the design includes a safety circuit which prevents an electric shock to a person replacing a lamp or touching the two conducting prongs within the lamp holder.

With the inclusion of software-controlled micro circuitry further control functions are incorporated. For example, when the external circuit is a light circuit, a tungsten lamp life extender, auto or resettable lamp brightness control, auto lamp turn off after pre-set time expires, random light turn on/off, slow fadeout control for childrens bedrooms function are incorporated.

When the external circuit 46 is a light circuit and the light itself is a tungsten lamp, the control circuit will gradually increase the voltage supplied to the lamp. In that way, cold inrush current is reduced and early burn-out of the lamp is prevented.

A dimmer is provided to enable control of the intensity of the lamp. By maintaining the hand over the plate 16 for more than one second, a dimmer mode is activated. Maintaining the hand in place results in successive dimming of the lamp. The hand can then be removed from the switch when the desired lamp intensity is reached.

In the present embodiment further functions are incorporated and may be indicated to the user by means of pulsing the lamp on and off. To enter a programming mode to access such functions the lamp is turned off and the hand is maintained over the plate 16 for a total of ten seconds. The circuit will then enter auto-turn off programming mode. Each lamp pulse indicates a one minute delay before auto turn-off whereby the lamp will switch itself off automatically after the preset number of minutes have elapsed beyond switching on of the lamp.

Random light turn on/off for security purposes follows the steps above for controlling the lamp. The hand, etc is maintained for five seconds past the minimum dimness of the lamp and then each lamp pulse indicates a one hour delay before turn on, allowing a repeatable sequence to be maintained for each 24 hour sequence until disabled.

A comfort lamp function provides a progressive dimming overtime to a warm comfort lamp level. The function is set from switching the lamp on by maintaining the hand over the face plate until one delayed step in lamp level occurs then removing the hand. Over approximately a five hour period, which can be altered if desired, lamp will dim down to a pre-set brightness level to allow just a warm comfort lamp to remain on.

All of the above functions are programmed by the user touching the face plate and the various control options are presented sequentially.

Other applications of the contactless switch 10 include, switching electric fans, air conditioning, central heating, kitchen appliances, door bells, CNC machine data entry where the environment is oily, vending machines for vend selection, bank cash-point machines numerical keypads mounted behind plastic polycarbonate sheet for vandal resistance, hospital theatre equipment and appliances where hygiene is of paramount importance, access-control in "clean" rooms, public toilets in restaurants and food chains for operating foot-controlled solenoid-operated taps.

The contactless switch 10 could also have automobile applications. This type of switch 10 would provide vehicle console/dashboard designers with unlimited design possibilities. One example is to mount the contactless switch 10 behind the dashboard such that the plate 16 is co-planar with the dashboard which is less obtrusive than conventional switches/dials and the absence of protrusions makes it much safer than the conventional dash board in the event of a crash.

In this application, the contactless switch 10 would be normally fitted with bi-coloured l.e.d. indicators and/or an array showing the switch status, i.e. either on or off or mode selected, this also would aid finding the switch at low ambient light levels.

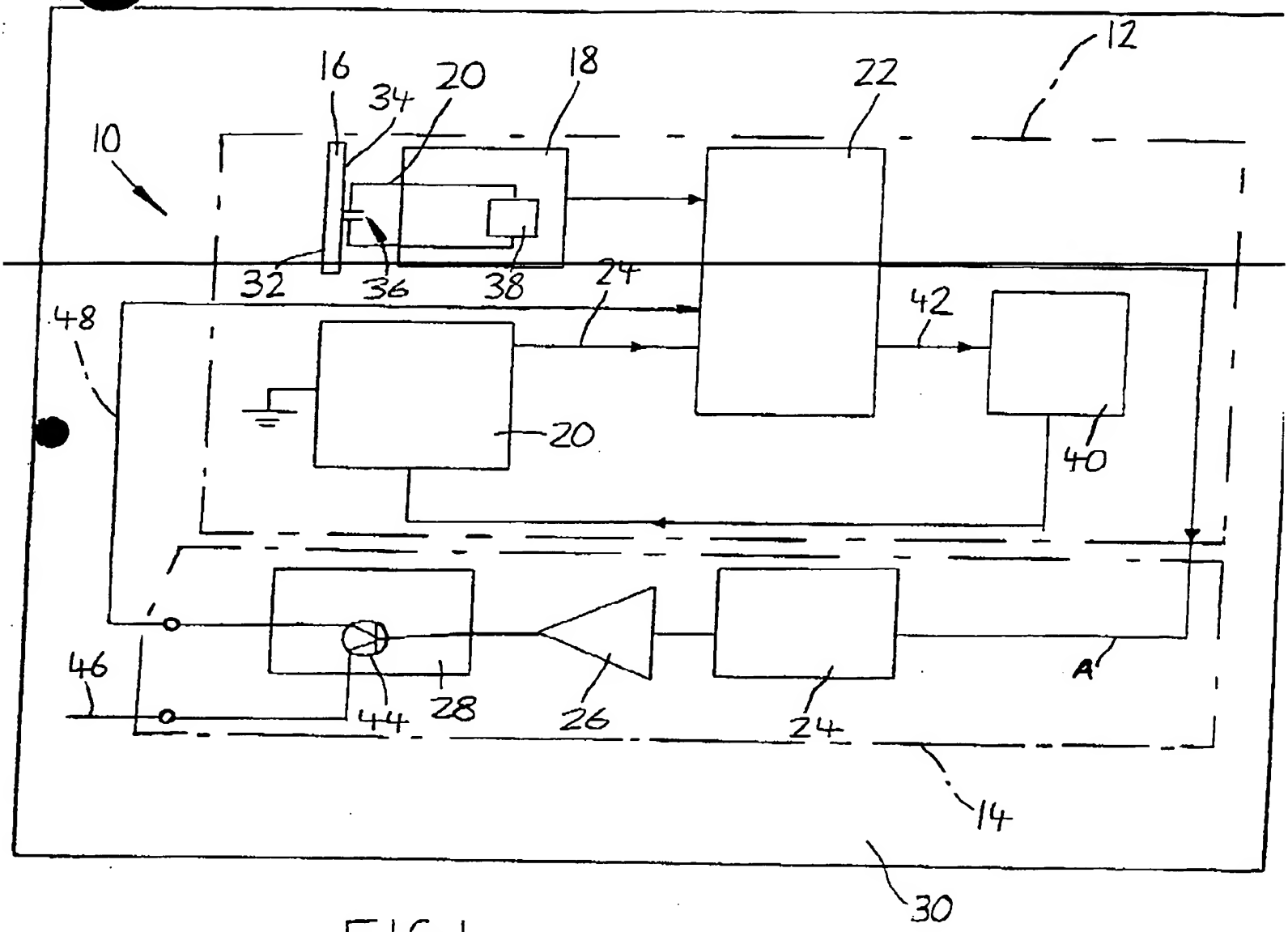

FIG 1